The Citrus Industry

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"Quick Decline" In California Oranges

. . . By Dr. A. F. Camp

Oil Deposits From Commercial Oil Emulsions

. . . By James B. Redd

Possibilities And Limitations Of DDT

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Possibilities And Limitations Of DDT....

Citrus growers are deeply interested in the possibilities of the newly discovered insecticide DDT now being so extensively used by the nation's armed forces. Not only are they interested in knowing just how and to what extent this new insecticide may be used in the control of insect pests in citrus groves but also in its application to the elimination of household pests.

A statement recently issued following annual meeting of the American Association of Entomologists in New York throws much light on the subject and will be of great interest to the owners of citrus groves. The statement follows:

"We feel that never in the history of entomology has a chemical been discovered that offers such promise to mankind for relief from his insect problems as DDT. There are limitations and qualifications, however.

"Subject to these, this promise covers three chief fields; public health, household comfort, and agriculture. As public health we include control of the insects which carry diseases that have scourged humanity, such as malaria, typhus and yellow fever. Household comfort is taken to cover such things as flies, fleas, bedbugs and mosquitoes. Agriculture includes not only farms, gardens and orchards but forests, livestock and poultry.

"In the public health field DDT insecticides are so much more effective than previous weapons against malaria mosquitoes that for the first time there is a practical hope for eradicating that disease from this country. DDT proved in Italy that it is the first and only practical control for typhus. In the household field its amazing lasting effect promises relief for months from flies, mosquitoes and fleas. In the case of bedbugs, eradication from the American home has become a possibility.

"In agriculture, it is promising against a wide variety of destructive pests. These include most potato insects, many orchard and vineyard pests, numerous vegetable insects, as well as the chief insect enemies of vitally important seed crops. It appears to be effective against the pink bollworm and outstanding against the Japanese beetle, two of our worst imported pests. It promises also a more practical control of the pests which ravage thousands of square miles of forest, and against many of those which harrass livestock.

"DDT will not kill all the important insect pests. It will kill many beneficial insects which are allies of mankind against the destructive species. Because of its toxicity to a wide variety of insects, its large-scale use might create problems which do not now exist. To illustrate, it is a superior insecticide for control of coddling moth on apples, but in some sections at least will kill certain natural enemies and thus release other insects which may then become ma-

(Continued on page 8)

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The coming of V-J Day will not mean the end to the demand for Florida fruit and food products, for even after the Japs are licked we will have huge occupation armies to feed, our own civilian needs which are not now supplied to the fullest extent must be met, and in addition we must do our big share in caring for the food requirements of the devastated countries of Europe.

So the production of food supplies, the utilization of and expansion of our by-products must be expanded . . . . and that is why we continue to keep our staff of research specialists busy studying the possibilities for better products and evolving new ideas in the development of food processing.

Practically every packer and canner in Florida already utilizes equipment we manufacture in the handling of Florida's crops . . . . equipment which has been designed to perform a specific function in connection with the packing and processing of food products which does its work in the most efficient and effective manner possible.

And our job is not ended here . . . . our research department is studying production problems of growers with the result that many innovations have already been developed which the grower finds invaluable to the cultivation, care and servicing of his crops. Our constant purpose is to improve the food industry of Florida.

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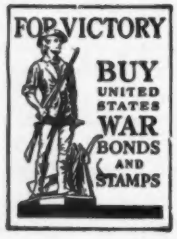

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Report On "Quick Decline" Inspection In California

A. F. CAMP
Vice-Director In Charge, Citrus Experiment Station, Lake Alfred, Florida

At the request of the Florida State Plant Board the writer proceeded to California to investigate the situation with regard to the so-called "quick decline." After contacting the various agencies involved the following statement seems to cover the situation as it now exists:

Starting in 1939-40 a few citrus trees on sour orange stock were reported as dying but their death could not be diagnosed as due to any of the common troubles such as: oak root fungus, girdling by pocket gophers (called "salamanders" in Florida) or pscrosis. These trees had no distinctive symptoms but simply declined to a nonproductive condition or died. A few additional trees were found in the next two or three years but did not cause any particular attention to be focused on the problem. In 1940 6 orchards were found affected, in 1941 16, in 1942 6, in 1943 9, but in 1944, 345 orchards were reported as having trees die from unknown causes. This great increase in number is probably more apparent than real as a field survey was made which probably found dead trees in a number of groves not hitherto listed but which were affected and moreover the publicity concerning this trouble in 1944 resulted in a great number of properties being reported by owners, and in fact many owners having dead trees occuring in their groves at present report them automatically as being due to "quick decline" without making thorough examinations.

The present figures on the number of groves involved and the number of trees involved are purely theoretical. In the first place the survey does not give accurate figures because at a casual glance the appearance of the affected trees is similar to the appearance of those dying from known causes and most of the survey work has not involved any digging up of roots and examination of trunks for girdling below the ground and the trees show no distinctive symptoms to distinguish them from trees dead from other causes.

It was found by Fawcett and his associates that in the early stages of the trouble starch disappears from the roots and a test for starch on pieces of roots was used as a basis for diagnosis. More recently this has not been found to be absolutely accurate as trees girdled by pocket gophers may show the same reaction. As a consequence it is problematic as to the number of trees actually involved but there are probably between 5,000 and 10,000 trees that have died from some unknown cause and may be classed under the term "quick decline". The Quarantine Service reported 9,500 trees as suspicious cases on a quick survey basis but many of them were not examined for girdling by gophers or for starch in the roots and it is anybody's guess as to the proportion of this number that may justifiably be classed as "quick decline."

The authenticated cases are all in Los Angeles county and practically all confined to the San Gabriel Valley. There are some doubtful cases in adjoining counties but these seem to be in the process of elimination. The trouble shows up on what is known as "washes" which are water ways which carry flood water in periods of heavy rains or heavy melting of snow but which are dry most of the time. These washes used to be wide with a gravel and sand structure of the bed. In recent years the width of the water course has been stablized by means of levees and other contrivances and citrus plantings have been expanded on to that part of the bed of the wash from which

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Oil Deposits From Commercial Oil Emulsions....

BY JAMES B. REDD
Florida Citrus Commission at the Citrus Experiment Station, Lake Alfred, Fla.

Oil sprays are noted for their inconsistent control of scale insects. This has resulted in a demand for research to determine the factors which cause variable results. Omitting thoroughness of application, some of the variables that contribute to the lack of uniformity of control are: amount of oil deposited on the foliage, the type of oil, its viscosity, boiling range and unsulfonated residue and the type of emulsifying agent used to emulsify the oil (3). It is the purpose of this paper to deal with only the amount of oil deposited on citrus foliage by oil emulsions. While future experimentation may differentiate between the insect kill and the tree damage caused by different oils (viscosity, type base and unsulfonated residue), these remarks are generalized for all oils known to be used commercially by citrus growers in Florida. These oils possess the physical constants: from 69 to 108 Saybolt seconds viscosity at 100°F., 75 to 92 unsulfonated residue and are either napthene or paraffin base oils. (Napthene base oils are synonymous with asphalt base and not to be confused with napthalene, a white crystalline solid used as a moth repellent).

Viscosity, as popularly understood, indicates in a general way whether the product is a light, medium or heavy oil. A 70 Saybolt second viscosity oil will evaporate faster than a 100 viscosity oil from the same stock. However, different stocks possess different viscosity characteristics, and a blend of light and heavy fractions will give intermediate viscosities.

The terms "unsulfonated residue" and "unsulfonatable residue" are used interchangeably and are abbreviated U. R. (1). The U. R. is the percentage of oil unaffected when treated with a specified concentration of sulfuric acid. For example, if a sample of oil is treated with 38N sulfuric acid and 10% reacts with and is dissolved by the sulfuric acid then 90% will be unaffected, and the U. R. is 90. Apparently the U. R. of an oil is not a critical a factor in Florida as in California (4), for oils are being used commercially here with a U. R. of 75 with no apparent increase in tree injury over the high U. R. oils.

The oil deposit is the amount of oil remaining on the foliage, irrespective of the amount applied as a spray. It cannot be overemphasized that the concentration of oil in the dilute spray emulsion does not determine the oil deposit! For instance, two different commercial oil emulsions may be applied at a concentration of 1.4% actual oil but the oil deposits from one spray may be much higher than from the other.

Apparently purple scale kill is related directly to the oil deposit and not necessarily to the oil content of the dilute spray. In cases where the oil deposit was higher from a 1.00% oil emulsion than from a 1.25% oil emulsion, the scale kill was higher from the 1.00% oil emulsion. Up to a certain point the same was true with other concentrations where the oil deposits were greater from the more dilute sprays.

Through a considerable amount of research a method has been developed to determine accurately the amount of oil actually deposited on citrus foliage. Because of the min-

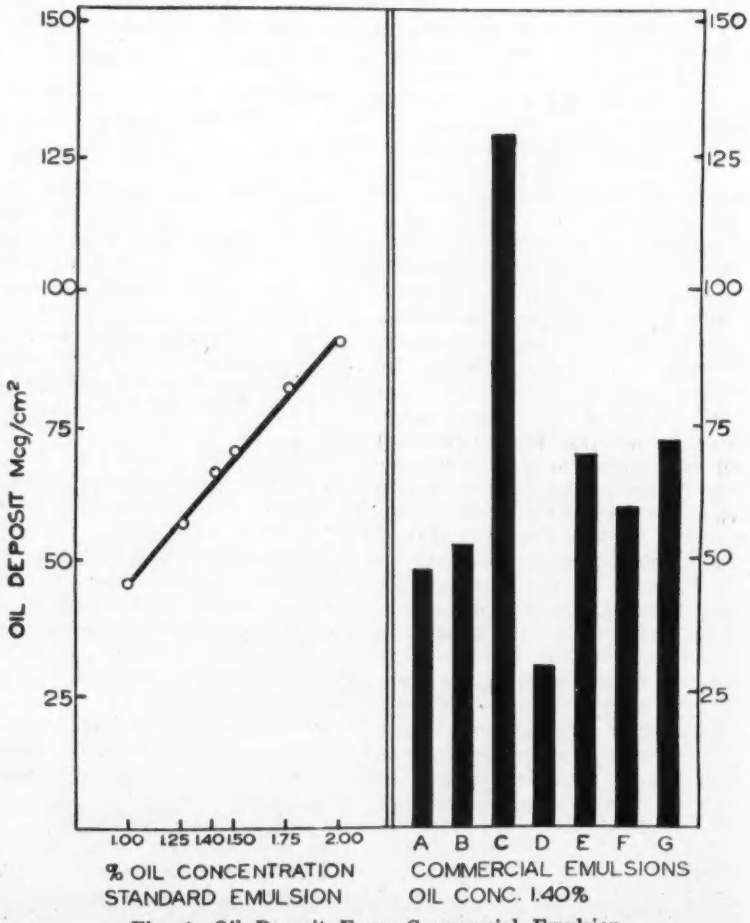

Fig. 1. Oil Deposit From Commercial Emulsion.

ute amount of oil deposited per unit area, it has been found advantageous to express this as micrograms of oil per square centimeter (mcg./cm.2) This is equivalent to approximately 2/10,000,000 (two ten-millionths) of an ounce per square inch. In this work the emphasis is on comparison of oil deposits rather than the units with which they are expressed. A 90% reduction in living scale has arbitrarily been taken as satisfactory scale control. In our experiments the indications are that 50 mcg./cm.2 of oil is necessary to give a 90% reduction in living purple scale. This does not mean that oil deposits below 50 mcg./cm.2 do not kill scale, but the scale kill does drop rapidly when less than 50 mcg./cm.2 are deposited. Conversely, the scale kill rises slowly toward 100% as the oil deposit is increased above 50 mcg./cm.2 The oil deposit at which damage to the tree results—in the form of excessive leaf drop and dead wood—is much more difficult to establish. The general tree vigor and weather conditions affect materially the amount of oil deposit a tree can stand. However, experiments so far have shown that the average healthy tree will begin to show an excessive leaf drop at about 90 mcg/cm.2 Then the limits for oil spraying should be 50 mcg./cm.2 or more for effective scale control and less than 90 mcg./cm.2 to avoid tree damage.

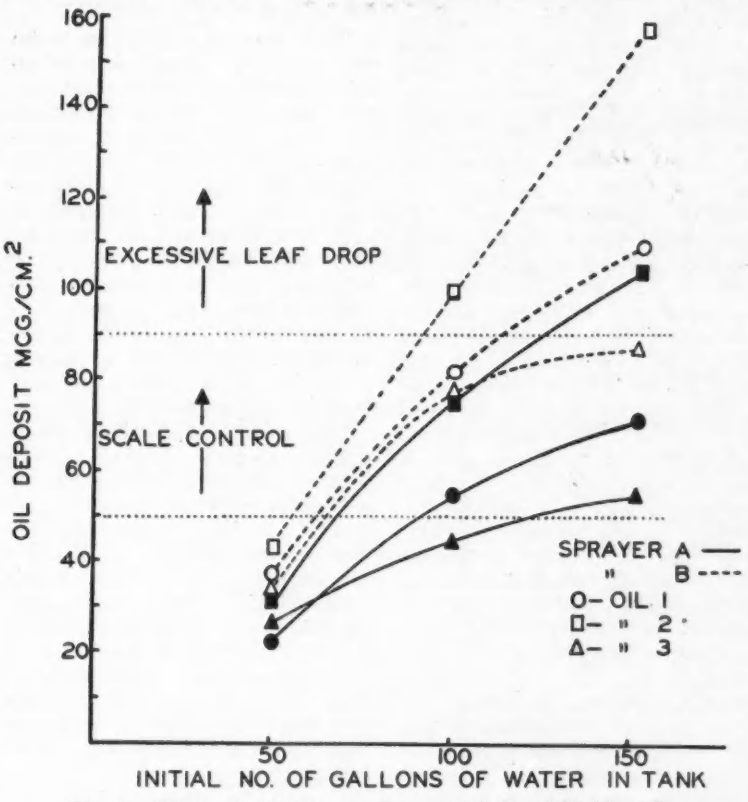

Fig. 2. Effect of Mixing on Commercial Emulsifiable Oils.

It is realized that the grower cannot make oil deposit determinations. These terms are introduced because experimentation has shown the limits between which the oil should be applied. It is the purpose of this paper to translate these findings into practical suggestions to enable the grower to improve his oil sprays.

Practical Application

The prime requisite when spraying with oil is thorough coverage. No amount of oil applied to one leaf can affect the scale on another leaf. The above data indicates why a spray with high oil depositing characteristics combined with a careless spray job can deposit enough oil on some leaves to cause injury while others do not receive enough oil to kill the scale.

Oil deposits from commercial emulsions. After determining the approximate amount of oil deposit necessary to kill purple scale, seven commercial oil emulsions were applied to citrus trees, each at a dilution of 1.40% actual oil to determine any variation in oil deposit. In order to have a standard emulsion for comparison a tank-mix emulsion that had been tested repeatedly was chosen for that purpose. Its oil depositing characteristics are listed in Figure 1. At 1.00% actual oil the deposit was 47 mcg./cm.2, at 2.00% 90 mcg./cb.2, and at 1.40% 67 mcg./cm.2. The seven commercial emulsions gave oil deposits listed in Figure 1 under commercial emulsions. Of the seven emulsions used at 1.40% oil, A and B gave oil deposits that are marginal for satisfactory control of scale while C deposited enough oil to be harmful to the tree. The oil deposit from emulsion D resulted in unsatisfactory scale kill while emulsions E, F and G were quite satisfactory. To give equivalent oil deposits from all these emulsions it would be well to apply A and B at about 1.50%, C at about 0.75% and D at about 2.00% of actual oil. Hard water, acid water or salt water tend to increase the oil deposition characteristics of an emulsion. The variation in oil deposit caused by the difference in water and equipment prevents the standardization of all the commercial emulsions for each locality. The

(Continued on page 9)

Fig. 3. The Effect of the Speed of a Speedsprayer on Scale Kill.

Plot	Miles Per Hour	Oil Deposit Mag/cm.2	Leaf Drop Av. Per Sq. Yd	Before Spra y Av. No. Living Scale Per Leaf	After Spray % Decrease of Living Scale
Speedsprayer					
G	1.2	46	229	3.36	94
I	2.3	29	147	2.60	72
K	3.9	20	69	1.76	22
Check Plot					
J			47	2.86	+34
Pressure Sprayer					
A		41	238	6.12	85

"QUICK DECLINE" IN CALIFORNIA ORANGES

(Continued from page 5)

the flood waters have been excluded. Frequently this planting has required the hauling in of top soil. The worst cases seen were on this type of soil and in a few cases involved 50% of the trees in the grove. As the distance from these washes increases there is a reduction in the number of affected trees. A casual visit in this area by one who was familiar with it would probably lead to the conclusion that it was due to the bad soil conditions were it not for the great publicity.

Usually the first indication of trouble in the individual tree is the failure of the tree to put out a normal flush of growth. This usually coincides with the presence of a heavy crop of fruit. The old leaves at this time take on a dull green which is a little hard to describe but is distinctive when seen in the field. Such trees tend to wilt in the middle of the day and soon begin to shed leaves and a little later the remaining leaves may turn yellow and fall rapidly. The rate at which the decline proceeds in the individual trees is extremely variable and may result in a quick wilting in some trees and other trees may linger on for a year or two with thin foliage and little or no growth. Starch disappears from the root system with the first showing of dull leaves.

Some trees when cut back severely at the early stage have made new growth and set some fruit and in these cases starch often reappears in the roots. Affected trees do not exhibit any particular symptoms to distinguish them. An examination of the root system of the affected trees shows that the feeder roots die first and then the larger roots. Only trees on sour orange stock have so far been found affected. Trees on sweet orange in the same area appear to be unaffected but there are not sufficient trees on other stocks to get any line as to whether they might be affected. Trees varying in age from one to fifteen years have been found affected with the heaviest mortality in the ten to twelve age group. Only orange trees on sour stock have been found affected and a few lemons on sour stock in the district seem to be unaffected. There has been no chance to check on grapefruit on sour stock as yet. The Experiment Station is interplanting one of the worst groves with trees on various stocks to obtain information on this point but it may take quite a long time to develop this information.

At the present time the status of the situation may be summarized about as follows: There are a considerable number of trees which have died in the San Gabriel water shed for which no cause can be assigned. The dead trees have no positive characteristics that may be used as unfailable diagnostic characters. No disease organism has been identified nor have transmission experiments been successful so the **cause is unknown.** There has been a tendency to believe that it may be a virus disease or a fungus disease affecting the roots of the trees but at the present time there is no concrete evidence concerning the presence of an organism nor has there been any evidence that the trouble can be transmitted from one tree to another but quarantine measures have been taken which are based on the theory that it **might be a transmittible disease** and not upon proof that it is a transmittible disease.

Research work has been carried on to cover the possibility that: (1) It may be a virus, (2) That it may be a soil organism attacking the roots such as a fungus or a bacteria. (3) That it may be due to nutritional conditions, and (4) That it may be due to bad soil or soil moisture relationships. Since there is no evidence that it can be transmitted by budwood there is naturally likewise no evidence that it can be transmitted through the fruit so that pending such further information the present Florida quarantine measures against nursery stock and budwood from California would seem to be adequate and about all that can be done. It is realized, of course, that a certain amount of budwood is brought in illegally by travellers and it should be stressed that not only because of "quick decline" but also for other reasons that this practice is likely to be dangerous to the interests of the citrus industry of Florida and should be discouraged by all citrus growers and handlers. This is probably the greatest source of possible transmission of disease from California to Florida at the present time.

POSSIBILITIES AND LIMITATIONS OF DDT

(Continued from page 3)

jor problems.

"The research reports emphasize that we have not had time to develop entirely satisfactory mixtures and dosages of DDT insecticides, nor methods and timing of application for many possible uses. Modern agricultural pest control often requires mixing several materials in combination treatments, and we know little of DDT's compatibility with many of those others. Researches thus far were made with a material which was produced under pressure for military needs, and which is not necessarily the best form for agriculture.

"We do not know enough about effects on plants, animals and soils. While most plants were not harmed by DDT insecticides in the experiments, injury to squash, corn, tomatoes and possibly fruit trees was reported. DDT is toxic to animal life when large amounts are taken internally or absorbed through the skin from oil solutions, but reports indicate a reasonable margin of safety. In the light of our present knowledge, heavy deposits on edible parts of plants should be avoided. Reports show definite toxicity to cold-blooded animal life including fish and frogs. There has not been time to learn the possible cumulative effects on soils.

"More and larger-scale experimentation is needed. Enough DDT for such research in 1945 should be provided."

The Borinquen Research Laboratory at Eustis, Florida, has been purchased by W. Donald Conkling. of Mount Dora and consolidated with his Agricultural Research Laboratory at the latter place.

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OIL DEPOSITS FROM COMMERCIAL OIL EMULSIONS

(Continued from page 7)

important point that the grower must realize is that the oil deposits kill the scale and the excess oil deposit causes tree damage. Too often it has been the practice to increase the oil concentration in the dilute spray when poor scale control actually resulted from poor coverage. In other words, it has been found that a much better scale control was achieved and less dead wood resulted from spraying a tree with 20 gallons of spray that deposited 55 mcg./cm.2 of oil than when spraying a similar tree with 15 gallons of a spray that deposited 78 mcg./cm.2 of oil. (The oil deposit was taken from leaves that are known to have been covered by the spray.) Before increasing the oil concentration in the dilute spray, the grower should observe living scale on foliage (preferably tagged) that he knows was thoroughly covered on both surfaces at the time of application.

Emulsifiable Oil. Emulsifiable oils are those oils in which an oil soluble emulsifier has been dissolved. When the oil with its dissolved emulsifier is added to water the emulsion is formed by the agitation in the tank. To detect any difference in oil deposit on citrus foliage due to the manner of mixing, three commercially available emulsifiable oils were emulsified in varying amounts of water in two different spray machines and the results are shown in Figure 2. The sprayers were identical except for agitation. Both tanks held about 300 gallons. The agitation in sprayer A is obtained by four twin bladed propellers turning at about 250 times a minute which results in very vigorous agitation. However, sprayer B has only two triple bladed propellers that turn at about 180 times a minute which is the standard equipment for that make of sprayer. In the first series of experiments, fifty gallons of water were placed in both tanks, the agitation started, the emulsifiable oil added and agitated for two minutes. The resulting emulsion was diluted and sprayed on citrus trees. The oil concentration in the diluted emulsions in all cases was 1.40%. As shown in Figure 2, all three oils with both sprayers gave low oil deposits and in most cases poor scale control resulted. To further test the effect of the initial amount of water in the spray machine on the effect of the resulting emulsion, 100 gallons of water were placed initially in the tanks and the experiments repeated. As shown in Figure 2 all oil deposits with both sprayers were higher—indicating a looser emulsion. However, the oil deposit from oil No. 3 with sprayer A was too light while oil No. 2 with sprayer B deposited too much oil. The other four oil deposits

(Continued on page 11)

Let's NOT forget

. . . that in spite of adverse weather conditions and a critical labor shortage the groves of Florida must be kept in the best possible condition.

. . . that proper care of the groves this summer will not only protect, mature and size the fruit now on the trees but will also help the trees themselves store bloom wood for next season's crop.

. . . that for your summer spraying program VOLCK Oils have a wide margin of safety and show superior results in control of scale.

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HORTICULTURAL SOCIETY MEETING CANCELLED

Secretary Bayard F. Floyd, acting for the Executive Committee of the Florida State Horticultural Society, has issued a notice to all members cancelling the Fifty-Eighth Annual Meeting of the Society, due to the lack of approval of the War Committee on Conventions of the Office of Defense Transportation.

The meeting had originally been called for Winter Haven and the dates tentatively set for May 23 and 24, and it was with much regret that the Executive Committee found it necessary to cancel the meeting, which has come to be looked upon by citrus growers as one of the high spots of the year.

But, while no meeting will be held, the papers prepared for presentation at the meeting will be assembled and will be printed as the proceedings of the Fifty-Eighth Annual Meeting of the Society and a copy will be mailed to each member of record at the time of going to press.

Members of Executive Committee point out that inasmuch as no meeting will be held, there will probably be some shrinkage in annual membership, and there will also be some additional expense. For this reason it is urged that all members who can do so send the treasurer their check for $10 for an annual sustaining membership instead of the usual annual membership. Remittance should be made to Frank L. Holland, Treasurer, Winter Haven, Florida.

It is to be regretted that circumstances prevent the holding of a meeting this year, but the members of the Executive Committee are to be congratulated on their decision to publish the papers prepared as the official proceedings of the meeting.

"THE CITRUS INDUSTRY OF FLORIDA"

A two-hundred-page booklet under the above title has just been issued from the office of Commissioner of Agriculture Nathan Mayo. It is without question the most authoritative and important booklet on citrus growing, processing and marketing in Florida that has ever been issued, covering as it does every phase of the industry.

Part One of the book is devoted to "Citrus Growing in Florida" by Dr. A. F. Camp, Vice-Director in Charge of the Citrus Experiment Station at Lake Alfred. Dr. Camp is one of the outstanding authorities on citrus in the state and he handles the subject in masterly manner from the early history of citrus down to the present time. The data submitted and the illustrations presented bring clearly to the mind of the reader the important steps in the development of the industry in the state.

Part Two is devoted to "Packing House Operations." This phase of the industry also is covered by Dr. Camp, who carries the operation step by step from the picking of the fruit in the grove to the final delivery of the packed containers on the loading platform.

Part Three is devoted to "Citrus Marketing" and is covered by Robert C. Evans, Secretary-Manager of the Florida Citrus Commission. Attention is called to maturity tests, grade standards, approval of licenses, artifical coloring, registration and use of labels, proper filling of containers, and other matters of interest to shippers.

Part Four has to do with "Citrus Processing" and this subject is covered by L. G. MacDowell, Director of Research of the Florida Citrus Commission. This field is covered from the inception of citrus canning in the early 1920's down to the elaborate establishments now engaged in the processing of Florida's citrus fruits and the parts thereof which only a few short years ago were considered waste and dumped in unsightly heaps along the roadsides.

Part Five is concerned with "State Institutions and Agencies Serving the Citrus Industry." Among these are the Department of Agriculture, The Florida Citrus Commission, the State Plant Board, the University of Florida and the College of Agriculture, all of which agencies are vitally concerned with the success of the industry.

The booklet contains much valuable information which is of interest to everyone concerned with the industry, whether he be grower, packer, shipper, canner or manufacturer of by-products—and it is authoritative.

ALL CITRUS RECORDS BROKEN

In spite of extensive storm damage and a short shipping season, Florida's citrus crop brought more money into the state than ever before in the history of the industry. This is demonstrated by a survey just completed at the close of the 1944-45 shipping season.

J. C. Townsend, Jr., citrus statistician for the bureau of agricultural economics, places the value of the season's citrus crop f. o. b. cars at $163,640,000 or $13,920,000 more than the value of the previous year's crop. This in spite of the fact that the shipping season closed earlier than in any year since the season of 1930.

H. P. Willson of the Federal-State market news service, places the on-tree value to growers at $2.36 per box for oranges; $2.23 per box for grapefruit, and $2.17 per box for tangerines. The auction averages were $2.10 per box higher for oranges, $2.00 per box for grapefruit and $2.65 per box for tangerines. These prices were the highest received for Florida citrus during the past fifteen years.

OIL DEPOSITS FROM COMMERCIAL OIL EMULSIONS

(Continued from page 9)

were satisfactory. One hundred fifty gallons of water were placed in the tank and the experiments were again repeated. Oil No. 1 was too loose when mixed by sprayer B, while oil No. 2 was too loose with both sprayers. In fact, oil No. 2 in sprayer B failed to emulsify, and oil deposits were very uneven throughout the application. Figure 2 illustrates the oil deposit when there was about 100 gallons left in the tank. The last tree sprayed with that mix received much free oil, the oil deposit being well over 300 mcg./cm.2. The tree was completely defoliated and severely damaged.

The method of mixing is of prime importance for emulsifiable oils, and the variation in mixing can be used to regulate the oil deposit. Emulsifiable oils of necessity must be made so that they will emulsify with any water and with all equipment, and since hard water (containing dissolved salts of calcium and magnesium) and salt water will loosen emulsions, enough emulsifier must be added to overcome this tendency. In localities where these conditions exist the emulsifiable oils would in all probability give every satisfactory oil deposits when mixed with an initial tank charge of about 50 gallons of water. From the above it follows that it is impossible to give a standard method of mixing emulsifiable oils. When these are used, it is strongly recommended that the manufacturer's recommendations be followed for his particular oil for those particular conditions.

Tank-Mix. In a tank-mix, as differentiated from an emulsifiable oil, the emulsifier is dissolved in the initial charge of water (usually about 50 gallons) and the oil is added to the solution with agitation to form the emulsion. While the process of emulsification—and the limitations—is the same, the grower enjoys distinct advantages over the manufacturer of emulsifiable oils. The grower can have an intimate knowledge of his equipment and water and the tank-mix can be formulated to fit his special conditions. Usually the amount of emulsifier is varied to meet varying conditions. A general rule for mixing is to add as little emulsifier as

(Continued on page 14)

J. K. HOYT said it . . . .

"Yes, sing the song of the orange-tree,
With its leaves of velvet green;
With its luscious fruit of sunset hue,
The fairest that ever were seen."

FLORIDA growers join Poet Hoyt in proclaiming the beauty of the orange tree — yes, and when they reap a bountiful harvest, they too "sing the song of the orange tree" with enthusiastic praises.

However, Florida growers know what Hoyt failed to mention — that it takes a lot of work to keep an orange tree healthy so that it will produce "luscious fruit of sunset hue," and continue to be a thing of beauty to both the grower and poet.

Florida growers realize that one of the most important means to high quality and productiveness is proper fertilization. Many of these successful Florida growers use Gulf Fertilizers. They know that Gulf Fertilizers are the result of more than 40 years of experimenting and field testing. Growers have found that Gulf Fertilizers are keyed to Florida soils — that they supply all of the essential plant foods.

Florida farmers like Gulf Field service, too. They know that they can rely on the Gulf Field Men to give them accurate advice about kind, amount and timing of fertilizer applications.

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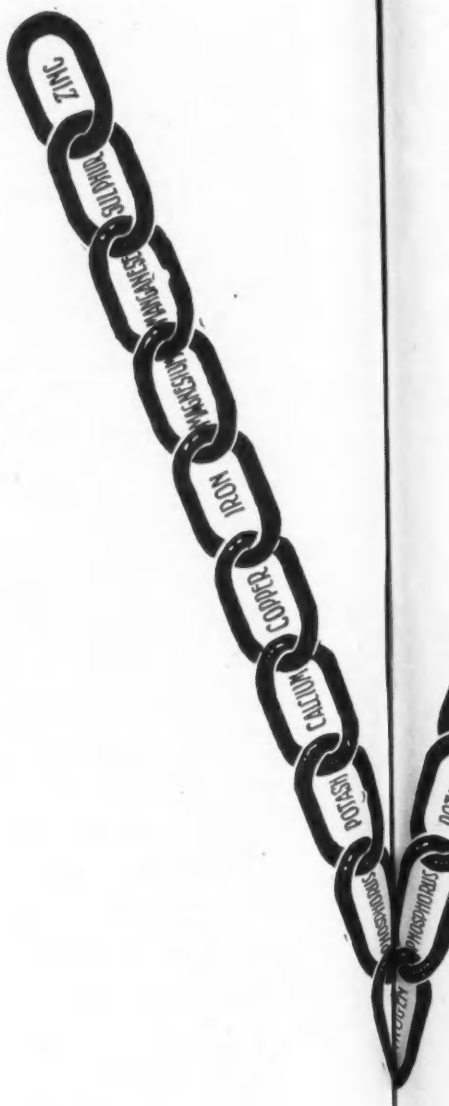

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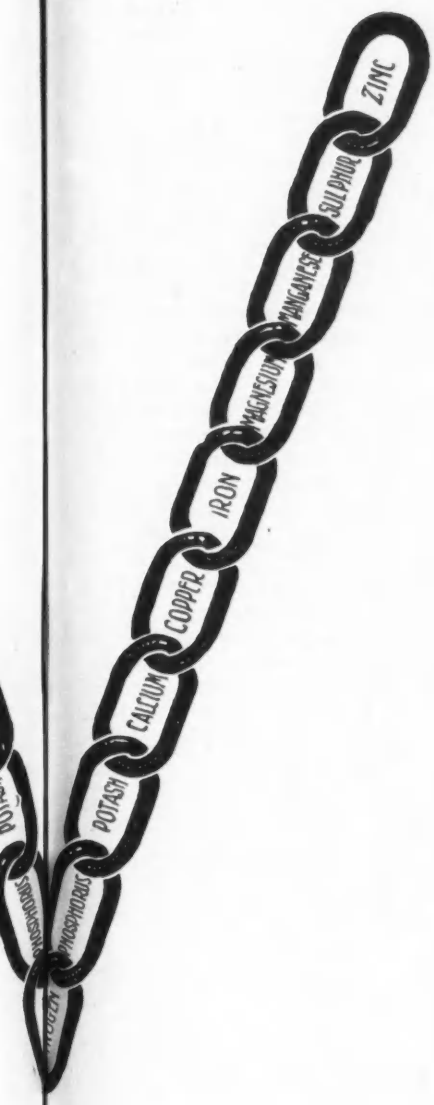

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OIL DEPOSITS FROM COMMERCIAL OIL EMULSIONS

(Continued from page 11)

possible so that the diluted emulsion does not break (free oil separating out) in the tank before it has been sprayed out. When the oil is added to the initial charge of water, it is agitated until no free oil is visable and the contents of the tank is as white as the return from the pump overflow. It must be pointed out that in order to use the tank-mix successfully that considerable experience and "know how" and thoroughly reliable spray crew must be possessed by the grower. There have been cases through neglect of the spray crew in which no emulsifier (or the incorrect amount) was added for the tank-mix with disasterous results.

Fig. 4. A Comparison of Results From the Pressure Sprayer and Speedsprayer.

Location Of Leaf Sample	Oil Deposit Mcg./cb.2	Leaf Drop Av. Per Sq. Yd. E.W.	Leaf Drop Av. Per Sq. Yd. N.S.	Before Spray Av. No. Living Scale Per Leaf	After Spray % Decrease of Living Scale
Speedsprayer					
Row L					
Low Outside E. W.	54	178	203	12.04	94
Low Outside N. S.	39			17.48	88
Low Inside E. W.	49			38.20	84
Low Inside N. S.	36			46.00	70
Top Inside	52			17.00	89
High Outside E. W.	53			4.88	85
High Outside N. S.	47			5.32	68
Row M	72	207	228	21.90	92
ROW N	74	255	253	27.40	97
Pressure Sprayer					
Row A					
Low Outside E. W.	43	242	232	6.25	87
Low Outside N. S .	40			4.44	77
Low Inside E. W.	42			42.50	93
Low Inside N. S.	47			34.20	87
Top Inside	36			6.37	82
High Outside E. W.	40			2.24	70
High Outside N .S.	35			2.80	67
Row D	41	130	126	1.23	80
Row E	39	172	179	2.23	75

Broken Diluted Emulsions

Severe injury has resulted from reagitating broken dilute emulsions and spraying them. When emulsions are diluted and are not used immediately (due to mechanical breakdown, rain, noon or quitting time), the emulsion begins to break and the oil rises to the top. Different emulsions will stand diluted for different lengths of time before breaking. Complete breaking is a gradual process over a period of a few minutes to a few days, depending on the type of emulsion. Agitation does not reemulsify the broken emulsion to any significant degree. For example, suppose a dilute emulsion has been standing for one hour and 50% of the emulsion has broken. On stirring, the 50% **unbroken** emulsion will give a white appearance to the mix but the free oil will tend to float to the top in spite of the agitation and will be sprayed as free oil on the last tree with injurious results. The agitation does break up the free oil and it is dispersed throughout the emulsion so that no free oil can be seen when the agitation is in progress. Trying to reemulsify the oil is just the same as making a tank-mix or using an emulsifiable oil by filling the tank completely with water and then adding the oil. It has already been pointed out what happens when mixing emulsifiable oils when the tank is only half full of water. One of the best ways to tell if a diluted emulsion has broken is to reagitate for a short time (about two or three minutes) and then stop the agitation. If the emulsion has creamed (the emulsion itself rising to the top—a process indentical with the creaming of milk) this agitation will thoroughly mix the emulsion again; if the emulsion had broken, the free oil will be dispersed and will rise quickly to the top once the agitation has stopped. If any considerable amount of free oil appears on the surface of the emulsion within one minute after the agitation has stopped, unless advised specifically to the contrary by the manufacturer, the oil should be dumped. To avoid this difficulty as much as possible the grower should arrange with his spray crew to take their noon hour and quitting time at the end of a tank.

Mechanical Sprayers

Efficient scale control will not be obtained when mechanical sprayers are driven too fast. Scale control cannotbe obtained by increasing the oil concentration of the dilute spray when thoroughness of application is the limiting factor. Figure 3 gives the results of a Speed-sprayer driven at different speeds. The oil content of the emulsion in all tests was 1.40% actual oil. The trees were 15 to 18 feet high with fairly open foliage and would not be considered difficult trees to spray. The speed was checked by the time required to spray several trees a known distance apart. For instance, at 1.2 miles per hour it took 142 seconds to spray 10 trees that were spaced 25 feet apart. From Figure 3 it is obvious that speeds much greater than 1.2 m.p.h. did not give satisfactory scale control. It was necessary to apply just as many gallons—or more—by the Speedsprayer than it was by a thorough inside and outside walking job with the pressure sprayer. Operators should check the time required to spray 10 trees until they can consistently drive about 1.2 miles per hour. Speedsprayers have been observed driving as fast as 4 miles per hour applying oil sprays. It is a common practice to drive faster when spraying small trees. Similar results were obtained as in Figure 3. Increasing the speed decreases the oil deposit which results in unsatisfactory scale control. To control gallonage on small trees it is suggested to cut off the top nozzles and to close the master valve between trees.

Figure 4 shows the scale kill in different parts of the tree from both Speedsprayer and a pressure sprayer. The Speedsprayer was driven at 1.2 m.p.h. and about 31 gallons of spray per tree was applied. The pressure sprayer required about 22 gallons of spray per tree. The same emulsion at 1.40% oil was used in both machines. The Speedsprayer was traveling North and South and it is noticed that North and South (especially the low sides) were the ones with the minimum oil deposit and minimum scale decrease. The scale kill fol-

lowed roughly the oil deposit. Satisfactory scale kill was recorded with oil deposits less than 50 mcg./cm.2. However, good scale kill was not consistently achieved with oil deposits below 50 mcg./cm.2.

Corroborating Chapman et al., (2) it was found that deliberate overspraying a tree with twice as many gallons increased the oil deposit by 15 to 30%. However, if a spray is applied and allowed to dry and then another application made the oil deposit is about doubled. In Figure 4 Row L, one side was sprayed and the other side sprayed long before the other application had time to dry. Rows M and N were sprayed on one side and allowed to dry and then the other side was sprayed—a common practice in the field caused by long rows. It will be noticed that the oil deposit was much greater than on Row L. Much dead wood—specially from the top and the center of the trees—was cut from Rows M and N whereas little had to be cut from Row L or any of the other plots where the second half of the trees was sprayed before the oil had dried on the side sprayed first. Although the average oil deposit on leaves picked at random of the outside canopy of Rows M and N was about 72 mcg./cm.2, the inside oil deposits were sometimes over 100 mcg./cm.2.

It has been stated previously that the amount of oil deposit necessary to cause tree damage was very difficult to establish. Groves with rows over 100 trees long have been sprayed down one side and then the other and it took five or six tank loads to make the round trip. One side was long since dry before the other was sprayed and yet no serious tree damage resulted. Other groves with much shorter rows were considerably damaged by the practice. The amount of oil deposit a tree can stand cannot be foretold, and for safety it is suggested to avoid having one sprayed side dry before the other side is sprayed.

It is recommended, therefore, when using a mechanical sprayer not to allow the sprayed side to dry before spraying the other side. If the rows are too long, it is suggested that only part of the row be sprayed then turn around and spray the other side. For example, if the rows are 100 trees long, spray 33 or 34 trees on one side turn around and do the other side. After the first third of the grove has been sprayed, move down and spray the middle third and finally the last third. This is an extra nuisance but it may be well worth the trouble in the form of less dead wood. If the grower has two speed sprayers at his disposal, reverse one head so that it sprays to the right instead of the left and let one machine follow the other at a short distance on the other side of the row.

When using pressure equipment, do not finish spraying a tree upon

(Continued on page 22)

Every Time You See A Truck

Loaded With Florida Favorite FFFertilizer You Know That Some Grove Is Going To Be Made Happier . . .

There are hundreds of growers in Florida's most prolific citrus section who will vouch for the never varying high quality of our FFFertilizers.

These same growers will tell you that not only do we provide them with the type of fertilizer which their particular groves require, but that our own trucks deliver that fertilizer as their requirements call for it.

ONLY AN OUTSTANDING PRODUCT AND DEPENDABLE SERVICE

Can account for the steady growth which this company has enjoyed over the long period of years during which it has served the Growers throughout Florida's citrus belt.

Dry weather has retarded fertilizer applications somewhat this season, but where sufficient moisture exists now is the time to see that your groves receive their summer application of FFFertilizer.

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The LYONIZER

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Reports Of Our Field Men . . .

HILLSBOROUGH & PINELLAS COUNTIES

C. S. (Charlie) Little

Most of the packing houses in this section have closed for the season and shortly after the first of June will see all of them closed as any fruit remaining on the trees will go to the canner. To date we have had only a light amount of rain and in many cases these showers have been spotty and as a result we have a number of groves that are suffering quite badly from the dry weather. Many growers that have been getting their irrigation water from lakes are having to discontinue their operation because of lakes going dry. As previously stated we had a very heavy early bloom all through this section but now it appears that we are going to have one of the lightest crops of fruit that we have had in many years. However, this will be overcome to some extent if we get a late bloom and can get it to stick on the trees. This light crop is especially noticeable on common grapefruit and valencia oranges.

WEST CENTRAL FLORIDA

E. A. (Mac) McCartney

For a number of months now I have been talking about adverse weather condition of one nature or another. I am still talking about the same thing—dry weather and more dry weather. We have had some light rains in certain localities and they have been wonderful but in other sections in this territory we have groves that are really suffering—the trees are wilted, the fruit is falling and many growers are hoping, and praying some too I guess, but it is still dry. There is no question in my mind about there being a considerable shortage of fruit this fall and the next spring unless we can get a bloom real soon. Maybe a good June bloom will solve the situation. We have been going right along with our summer application of fertilizer and if the present movement continues we will be through by the middle of June. The vegetable season has come to a conclusion with those growers who were equipped with irrigation having a successful season while those without water, in most cases lost money.

NORTH CENTRAL FLORIDA

V. E. (Val) Bourland

There is a small amount of fruit in this territory to be moved either to the canner or the fresh fruit market but it is getting hard to locate and it looks to me as if the season will be over shortly after the first of June. Growers have been busy trying to get their grove properties irrigated and at the same time take care of their summer application of fertilizer. In many cases it has been too dry to do very much with the spray program but just as soon as we get some rain the spray machines will be going overtime. The dry weather has been very detrimental to the watermelon crop in this section but even with small sizes the prices have been good and most growers should more than break even. The vegetable deal is just about over and as a general rule producers have been able to show a profit. There has beeen a large acreage of citrus trees planted in the territory during the past few months and the owners have had much difficulty in keeping them watered sufficiently to maintain their life. There has been a large number of trees in this new planting that have died.

SOUTHWEST FLORIDA

F. W. (Felton) Scott

Last fall we started the season with the hurricane, then we had a freeze, and now we are in the throes of a very severe dry spell. However, in true farmer style the growers of the section have worked harder, sweated more, slept less and have produced their crops and as far as I can learn most of them have finished the season without losing their shirts. To me it seems that this bunch of men are entitled to the highest award that anyone could be awarded for they have certainly won it in their efforts to keep the food rolling to both the civilian and armed forces. Groves throughout the territory with only a few exceptions are in bad shape. They have never had a chance to recover from the hurricane and now with the prolonged drought they just could not be in tip-top condition. We have lost a great deal of the early bloom, and in some cases where we had a later bloom this has been lost too. Taking everything into consideration it is a good bet that our crops will be light this coming season.

POLK & HIGHLANDS COUNTIES

J. M. (Jim) Sample

We have had some showers in this territory but not nearly enough to take care of our needs at this time. Growers throughout the section are still running their irrigation plants and it is true that those growers that were able to keep their grove properties watered are just about the only ones that have any fruit crop set for the coming season. Many growers have been very anxious to go forward with their spray program but due to the wilted conditions of their trees they just haven't been able to keep up with what they wanted to do, what should have been done. In some cases the post bloom copper spray will not be added, and the next spray will be the oil application for the control of scale. Growers have been going forward with their summer application and we will be through with this operation by the middle of June. There are some individual crops of fruit that has yet to be moved to market but this is being done as rapidly as possible and it will be only a matert of a few days until everything will have been moved in this territory.

LYONS FERTILIZER COMPANY FIELD MEN ARE ALWAYS GLAD TO BE OF SERVICE TO YOU. DON'T HESITATE TO CALL UPON THEM AT ANY TIME YOU MAY NEED THE SERVICES THEY WILL GLADLY RENDER.

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Talked with a feller the other day who said on account of the dry weather his trees had dropped sich a lot of leaves and fruit that he figgered he wouldn't use as much fertilizer as usual this year. Now that sort of figgerin' is just about as wrong as anybody could get. 'Cause when it does start to rain old lady Nature is goin' to do her very darndest to replace all the foliage that has been lost, but in order to get the job done fast and well Nature's goin' to need more pounds of good fertilizer to help her out than she usually does.

When this does happen you are liable to have a heap more bloom too, and it'd be smart to add a lot of extra pounds to your fertilizer application if'n you want to hold that bloom and set a good crop. This here late bloom is goin' to be a big factor in makin' the market this fall. So don't skimp on the trees that are going to make your profit for you.

'N that ain't all. Groves has had a tough time the past six or seven months, startin' with the storm last fall. They ain't strong like they normally are. They're sort of weak and make good targets for disease and insects. Which is another reason why they should have a mighty generous supply of fertilizer at this time and why they ought to be sprayed so that the bugs will be put under control. Maybe you don't know all about what ought to be done but your fertilizer field man, your insecticide man, the folks at the experiment station or someone else can give you plenty of reliable dope about what to do. One thing is sure you ought to git rid of all the dead wood that's hangin' on your trees jist as soon as you possibly can.

'S a funny thing about Florida vegetable growers. The tougher the goin' is the better they seem to do. Take the labor shortage, the machinery shortage, the hurricane, the drought and the insects that we've had to scrap the past year, yet Florida vegetable growers had been turnin' out huge crops in spite of everything. For example during the week of January 12 we shipped 585 cars of vegetables from the Everglades alone and in the week of January 19th we'd jumped the shipments to 713 cars, and when you add these shipments to all the cars of vegetable stuff that we shipped from other parts of the state it's easy to see how we keep a big hunk of this nation and our armies and our allies loaded up with fresh vegetables.

Uncle Bill

The "Tristeza" Disease Of Sour Orange Rootstock

(Concluded from last issue)

Marloth also reported that "in cases where the stock has grown out after the death of the scion remarkably healthy and vigorous sour orange trees have resulted", and also that diseased trees of sweet orange on sour "when inarched in time with rough lemon seedlings, the top grows but the Seville (sour) stock dies nevertheless." Marloth states that when the Sampson tangelo is used as a stock for the sweet orange in South Africa, "its behavior is very similar to that of the sour orange when used as a stock". Contrary results with the Sampson Tangelo have been reported by Moreira (7) in Brazil.

Marloth suggested that the failure of the sour orange as a rootstock in South Africa may be a problem of mineral nutrition but gave no definite data in support of the hypothesis.

Recently it is reported that in Argentina and Southern Brazil the same or a very similar trouble has appeared on sour stocks budded to sweet orange, grapefruit, or mandarin varieties. Here, according to Camp (3), the sour orange, when grown as seedlings, is not visibly affected, and trees of lemon varieties on sour are apparently uninjured or at least not seriously influenced. All sours grafted to orange, grapefruit, or mandarin die, but if a sour sprout gets started from the root with sour foliage, it grows well. Also according to Camp, lemons on sour stocks do very well and peculiarly when sweet-orange trees on sour stocks start to decline they can be topworked to lemon successfully; the root system recovers and the trees are excellent, both from the tree standpoint and production.

The disease appeared in Argenina about 1931 and in Brazil about 1937. Numerous papers have appeared in these countries describing the desease and its spread; and researches on its cause and control, the writer understands, are being vigorously prosecuted. Only a small portion of these publications are available to the writer for consulation, but so far as can be determined from those available, the characteristic features of the disease conform almost entirely with those observed in Africa.

The most thorough treatment on all phases of the disease thus far published is contained in Bitancourt's papers describing the disease in Corrientes, Argentina (1, 2). He gives a list of susceptible, doubtful, and resistant combinations and of species grown as seedlings, as observed by him in Corrientes, and these conform entirely with the data from Africa. All ages of trees were found to be affected.

As cited above, Moreira (7) referred to the malady as the "tristeza" disease and described its rapid spread. All over Sao Paulo, sweet oranges on sour stocks almost all die, some very rapidly, but lemons on sour do not. He stated that Thornton tangelo as a stock is very susceptible, but that Sampson tangelo is completely resistant. This is contrary to the statement of Marloth, who found in Africa that Sampson tangelo as a stock reacted very similiarly to the sour orange (6).

As contributing to an understanding of this obscure disease, the following discussion may be helpful:

1. The idea that the cause of the trouble is due to the incompatibility of the sour stock with the sweet orange, mandarin, or grapefruit budded on it, as stated above, may be elminiated as a probable cause. The millions of successful trees of these combinations of stock and scion in many parts of the world, clearly testify to the full congeniality of these unions.

2. The particular variety or kind of sour orange used as the stock in Africa and other parts of the world where the disease occurs, may also be eliminated as the probable cause of the trouble, as stated above. This conclusion is primarily based on the fact that large numbers of trees budded in California and Florida on types of sour orange known to be congenial and successful were imported into Africa as buddings (budded trees) and there, when planted, regularly succumbed to the disease. It is certain that these trees, if they had been planted in California or Florida, would be alive today.

3. The Toxopeus theory. As this predicates the development in the sweet-orange top of some substance that is lethal to the sour-orange root, it necessitates that we assume this substance to be formed only in those localities where the trouble occurs, and not elsewhere. This is evident as the sour orange has been a dominant stock in most citrus regions for at least 75 years, and has been very successful.

It should be remembered that the particular products manufactured in any plant are commonly characteristic of that plant, and certainly very generally are produced in like degree and comparative quality in other countries and environments (note rubber, cincona, cloves, ginger, pepper, nutmeg and so on). The writer has been unable to learn of any case where a plant introduced into another country produced a different and novel constituent regularly. One plant though mutation might change, but certainly not all plants of the kind would change suddenly. It is thus inconceivable to the writer that sweet-orange varieties in Java and Africa would all be so affected as to produce some new and different substance, under all the variable conditions there existing, that was capable of causing the death of stocks which in other countries are normally fully congenial and successful.

4. Soil and climate conditions. Probably the first thought of every one who has studied the tristeza disease in the field is that it may be caused by some peculiar combination of soil and climate conditions. This possibly cannot yet be dismissed as a possible cause but, as pointed out by Toxopeus, it does not seem probable. In Africa the death of the trees occurred on all types of soils, sterile and rich; on hills and slopes and in deep rich alluvial river valleys; on sands, clay loams and loams; on virgin soils newly cleared and on old long-tilled areas. Also in Africa the disease, so far as could be learned, was equally severe in sections of

high and low rainfall; of summer and winter rainfall; under natural rainfall and under irrigation. The soils of affected sections also ranged from near sea level up to 4000 feet or more in elevation. The occurrence of the disease apparently in the same degree of severity under these varying conditions seems to the writer to probably preclude soil and climatic conditions as the primary causal agent.

Further evidence, though negative in nature, against soil and climatic conditions as a possible cause, is furnished by the fact that the disease is not known to occur in the older citrus sections, such as Italy, Spain, Florida, California, Palestine, Egypt, and Algeria, all countries in which the sour-orange rootstock has been widely and extensively used. The disease is so destructive that it certainly would have been noted had it acted as in Africa, Argentina, and Brazil.

5. Deficiency in minor elements. That the disease is caused directly by the lack of, or excess quantities of, any minor element of nutrition or toxic material in the soil, does not seem probable because of the successful growth of all of the spices concerned as seedlings grown on their own roots, or when budded on other stocks. This improbability is furthered by the reasons mentioned above under the preceeding heading.

6. Virus origin hypothesis, Bitancourt (1) stated that some virus latent in the sour orange and virulent in the sweet orange, which is transmitted through the bud union to the scion, would explain practically all the manifestations of the disease. This hypothesis, however, does not seem to conform with the fact determined by Toxopeus (9), that sour on sweet stocks grows successfully and that sweet when used as an interstock between sour and "Japanese citron" remains uninfluenced. It furthermore would not account for the death of the sour stocks when the sweet-orange tops are saved by inarching with "Japanese citron" or Rough lemon.

Toxopeus (9) concluded from his experimental tests that "In the writer's opinion this result can be explained only on the supposition that some strongly toxic action occurs from something manufactured in the leaves of Citrus sinensis." Toxopeus' results were clear-cut and definite and constitute the only careful experiments thus far reported. The reactions recorded, it would seem, cannot be questioned. The probability of this lethal agent's being a normal product of sweet-orange metabolism is discaused above. It would seem that if it is some constituent in the sweet-orange top that causes the death of the sour stocks, as suggested by Toxopeus, it must be something foreign to the normal metabolism of the sweet orange, that is, something extra, something acquired in the location where the trouble occurs. Carrying this thought farther, it would seem that the only material that could be acquired by the plant that could be expected to give such a reaction as indicated, so far as we now know, would be some virus that might be carried to the sweet orange by an unknown vector to which the sour orange is repellent, a virus not orange but which, when introduced into the sour orange, is toxic to that species. If however, Marloth (6) and Camp (3) are correct in their observations that sprouts from the stocks when they happen to get started, continue to grow, then it would seem that the introduction through the sweet top of a virus, lethal to the sour orange, could not be considered as a correct interpretation, for certainly such sprouts would be invaded by the virus.

A more serious difficulty must be overcome, however, in explaining how it can possibly be a virus disease when Camp states positively that trees of sweet on sour when they began to decline can be topworked to lemon and will then grow into successful commercial trees. The hypothesis that the disease is caused by a virus would also from the known conditions require that the mandarin and grapefruit attract the vector as does the sweet orange, and that they can be carriers of the virus without themselves showing visable influences of its presence. This seems to stretch the imagination rather far, but we have a similar case in the virus that causes the scaly-bark disease of the sweet orange, mandarin, and grapefruit. Fawcett (5) has shown that this virus may be present in the sour orange or the lemon without causing visible injury to the growth of production, but that if such trees are budded to sweet orange or

(Continued on page 20)

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The "Tailor-Made" Oil Spray

"NP" is an oil spray that can be "Tailormade" to suit your individual conditions simply by following the correct mixing procedure for your spray rig. Yes, by varying the amount of water in the tank, when "NP" is added, you can make an oil emulsion so suited to the individual conditions of your water supply, and the type of rig which you are now using, that it can give you the optimum scale-killing oil deposit you desire.

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Tampa Florida

"What Economic System . . . For America?"

The above is the title of a book just off the press of which Charles J. Brand is the author.

Mr. Brand on April 1 retired as Executive-Treasurer of the National Fertilizer Association, a position which he had held for nearly twenty years. Prior to taking that position he had been for twenty years associated in various capacities with the United States Department of agriculture. Thus for forty years he has been closely connected with agriculture and with an industry supplying essential needs of agriculture.

In "What Economic System for America" Mr. Brand analyzes and discusses communism, fascism and national socialism, comparing these systems with capitalism as it is known and practiced in America. From his study of the various systems he comes to the conclusion that neither communism, fascism nor national socialism is compatible with conditions existing in the United States nor with the mental attitude of the American people.

The book is well written, the figures given are authoritative and the conclusions are clear-cut and forceful. The book is worthy of wide circulation and careful study. It is just such a book as Mr. Brand's many friends would expect him to produce.

Mr. Brand is now consultant to the president of The Davison Chemical Corporation, Baltimore, Maryland, but his headquarters remain at 1111 Investment Building, Washington 5, D. C.

THE "TRISTEZA" DISEASE OF SOUR-ORANGE ROOTSTOCK 1

(Continued from page 19)

other susceptible varieties, the disease is transmitted to the scions, which are seriously injured.

In the various experimental propagations made by Toxopeus, using sweet orange, sour orange, and the unaffected "Japanese citron" in all possible combinations as tops, stock, and interstock, it was demonstrated that the only injurious and lethal combinations among the nine possible ones, were those where the sweet orange was used as the top or foliage part. The sweet had no injurious influnce when used as the stock or the interstock.

It seems to the writer more plausible, therefore, to assume that the disease is due to a virus, and then the simple assumption that the foliage of the sour orange and the lemon produces regularly and normally some product of metabolism that inhabits the action and development of the virus would explain all the difficulties now experienced in attributing the disease to a virus .

If this is assumed as correct, then sour on sweet would be healthy, while sweet on sour would die, which is the case; also sprouts from the sour stock if they developed foliage would be expected to grow without injury, which according to both Marloth and Camp is true; also if trees of sweet on sour are top-worked to lemon before they decline too far, then as soon as the sweet foliage is removed and the lemon foliage develops, the tree would be expected to recover, as it is known to do; also trees of sweet on sour inarched with resistant Rough lemon or "Japanese citron" would be expected to recover, and they do; but the original sour stock still supplied by sweet-orange foliage should die, and it does. Wherever the sweet-orange, mandarin, or grapefruit foliage forms the top, the virus would be expected to continue its activity, and apparently this is the case.

A variation of this interpretation, suggested to the writer by one of his associates, Dr. L. C. Cochran, is that the conditions can be equally well explained by assuming that the virus has tissue specificity for the leaves of the sweet orange, mandarin and grapefruit and develops that a toxin or substance which when translocated down is lethal to the sour stock. If the virus can infect sour orange, it fails to produce in the leaves of this stock substances which are toxic to sour-orange tissue. This interpretation is similar to the

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hypothesis given by Rawlins and Parker (11) in explainng the action of the buckskin virus in sweet cherry on mahaleb root stock.

This interpretation necessitates two asumptions: (a), that the tissue of the sour orange and the lemon do not possess toxin production specificity for the virus, or are immune to its attack; and (b) that the presence of the virus in leaves of sweet orange, mandarin, and grapefruit produces a toxin lethal to the two immune species. It seems more reasonable to the writer and more in harmony with known principles to assume merely that the sour orange and lemon are immune because they develop in their normal metabolism some product that renders them immune to the virus. In any case either interpretation is dependent on the assumption that the disease is of virus origin.

The fact that some citrus species manufacture products known to render them resistant to various diseases, while other nearly related species do not, is well known, and needs no confirmation. This is the case with virus diseases as well as with fungus and bacterial diseases. The food products and minor products of metabolism produced in the sweet orange are well known to be different in many respects from those produced by sour orange or by lemon. It is no strain on the imagination, therefore, to predicate that some substance developed in the foliage of sour orange and lemon inhibits the effect of the virus, or prevents its development.

Of all of the suggestions that have been considered, the virus hypothesis seems to the writer to be the only one that cannot be considered at this stage as improbable. It should be recognized that the injurious influence may be exhibited only in or on the roots, somewhat as the lesions of scalybark show primarily only on the stems or in the leaves. The extension of the disease from country to country and from province to province in time of appearance, strongly suggests the spread of an infectious disease.

In view of the fact that many millions of citrus trees of all ages throughout the oldest and most productive citrus regions of the world, especially Italy, Spain, Florida, and California, are on sour-orange stocks, the determination of the cause of the trouble is of major importance. It is an obscure disease which seems to be spreading. It was first recognized in South Africa about 1910, in Java in 1928, in Argentina about 1931, and in Brazil in 1937. In all of these countries, according to reports, it is very destructive. Vigorous steps should be taken to discover the cause of the malady and to determine how it can be prevented. Millions of trees are propagated on sour-orange stocks, and the destruction of all of these trees would constitute a major calamity.

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OIL DEPOSITS FROM COMMERCIAL OIL EMULSIONS

(Continued from page 15)

which a partial spray has dried. If a mechanical breakdown, or other trouble prevents a tree from being sprayed completely at one time, and the spray has dried before the trouble can be rectified, then the scale that are not killed by lack of coverage will probably do less harm than would the build-up of oil deposit caused by respraying the tree. Similiarily the rain might wash off some oil and decrease the scale kill but respraying is likely to cause severe injury. Do not respray the trees under these conditions.

Summary

It is the oil deposit that kills the scale, and the oil deposit varies with different emulsions and spray conditions. In general, it takes 50 mcg./cm.2 of oil to kill the scale and doses of over 90 mcg./cm.2 harm the tree. Considerable care and experience are necessary for the successful use of any oil spray and it is not the purpose of this paper to advocate one type over another but to enable the grower to obtain the maximum benefit from the oil of his choice. If a diluted emulsion is broken before it can be used, dump it. Drive mechanical sprayers slowly. Do not spray a tree with oil on which a previous oil spray has dried.

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